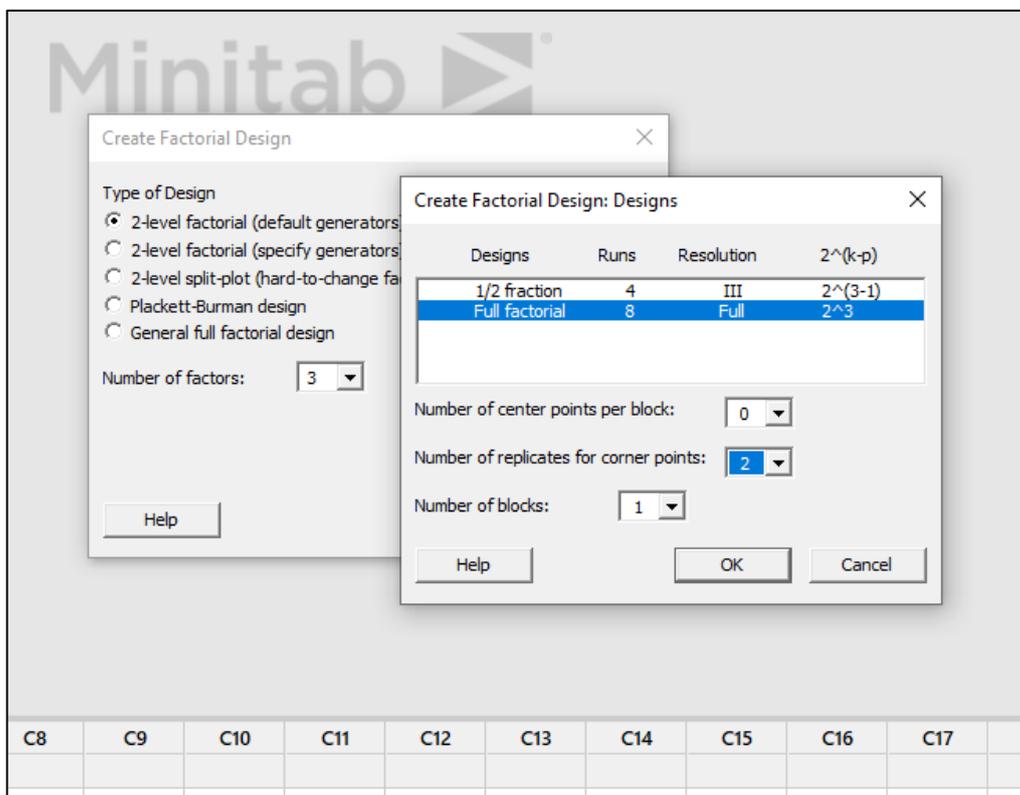
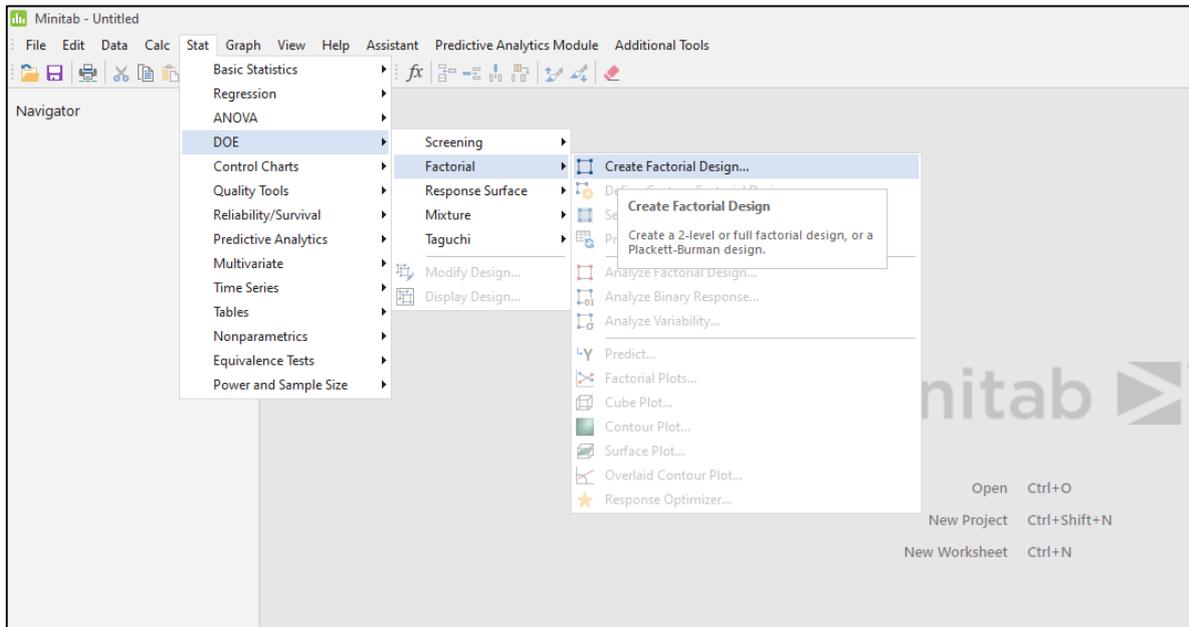
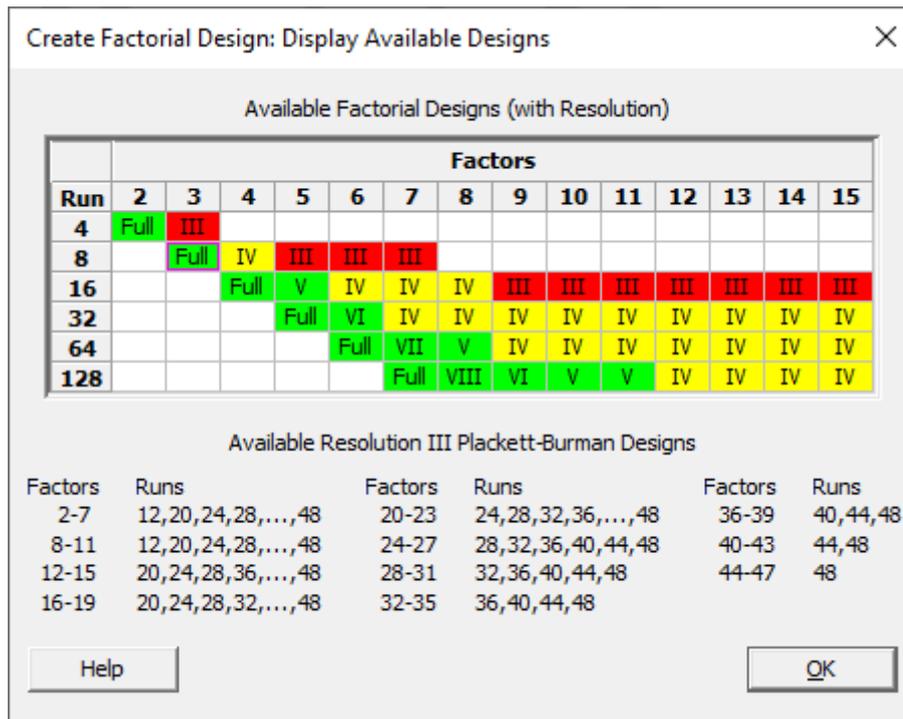


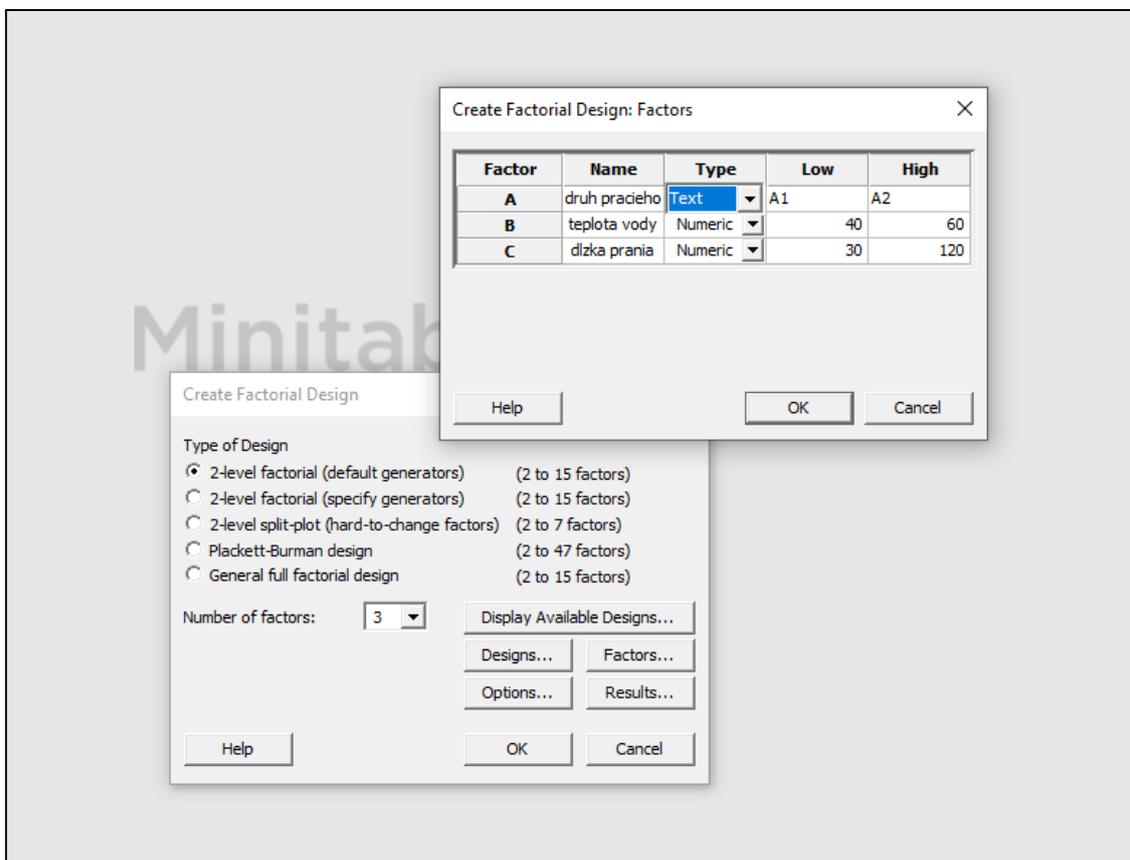
ÚČINNOSŤ PRANIA V ZÁVISLOSTI OD TROCH FAKTOROV – NÁVRH A VYHODNOTENIE ÚPLNÉHO FAKTORIÁLNEHO EXPERIMENTU V MINITAB-E

1. NÁVRH TYPU PLÁNU EXPERIMENTU 2^3





DEFINÍCIA FAKTOROV



Create Factorial Designs: Options

Fold Design

- Do not fold
- Fold on all factors
- Fold just on factor:

Fraction

- Use principal fraction
- Use fraction number:

Randomize runs

Base for random data generator:

Store design in worksheet

Help OK Cancel

Create Factorial Design: Results

Printed Results

- None
- Summary table
- Summary table, alias table
- Summary table, alias table, design table
- Summary table, alias table, design table, defining relation

Content of Alias Table

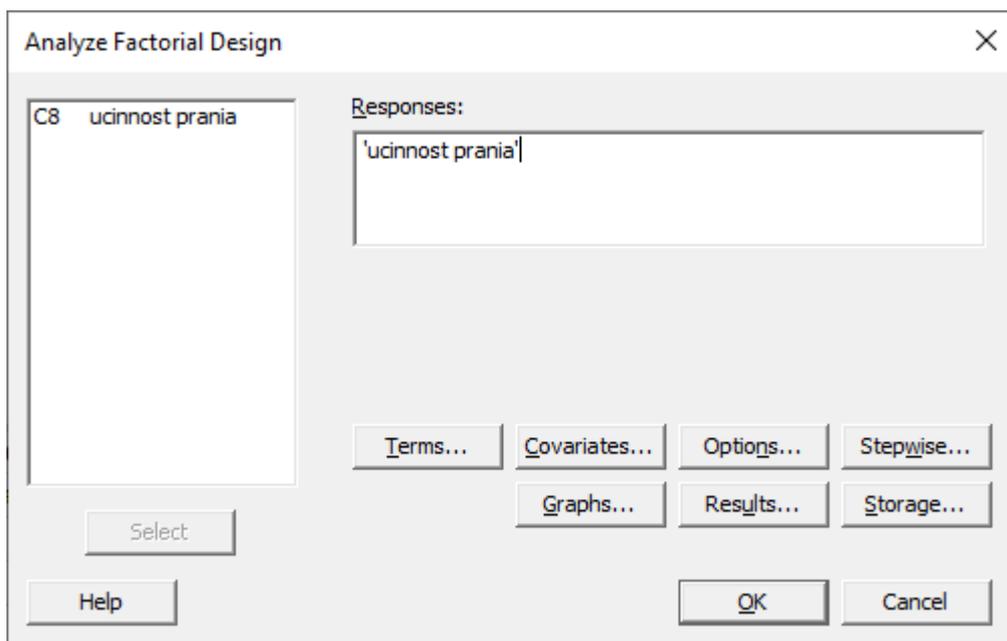
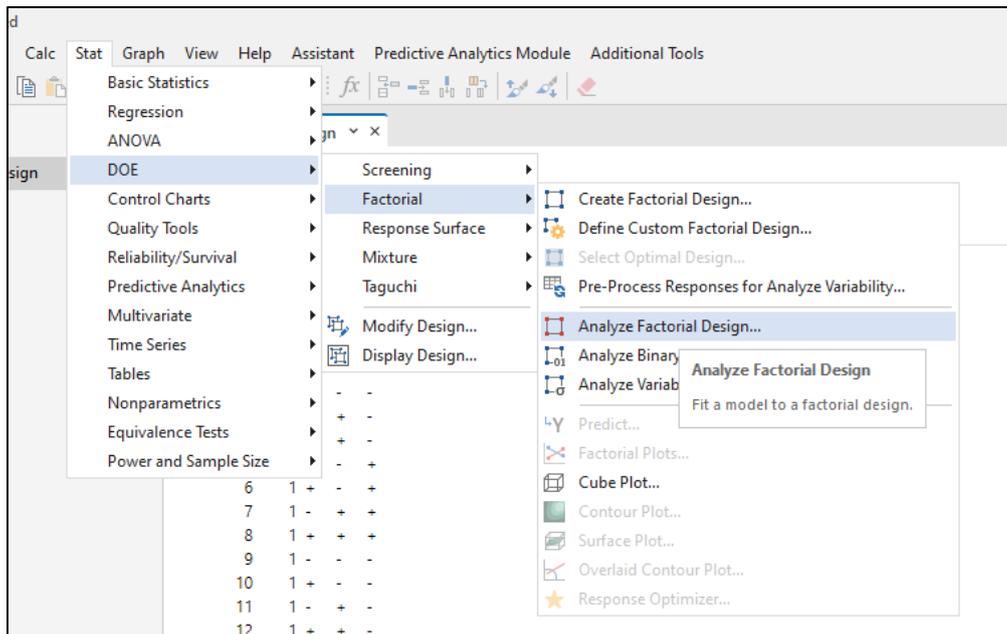
- Default interactions
- Interactions up through order:

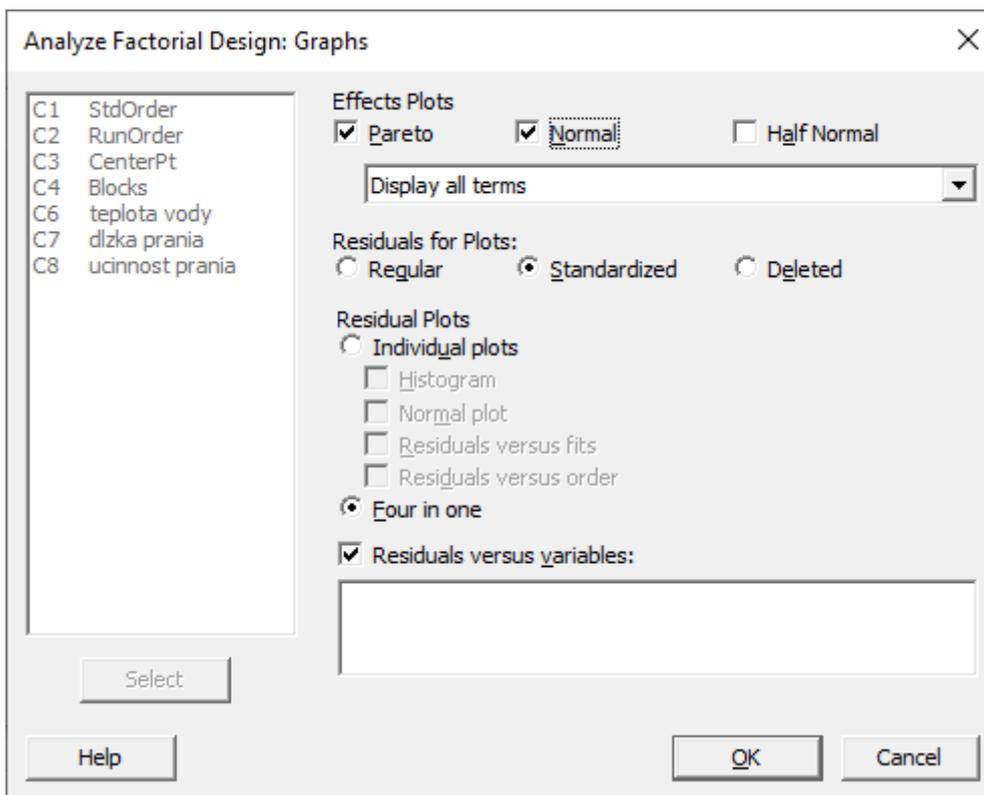
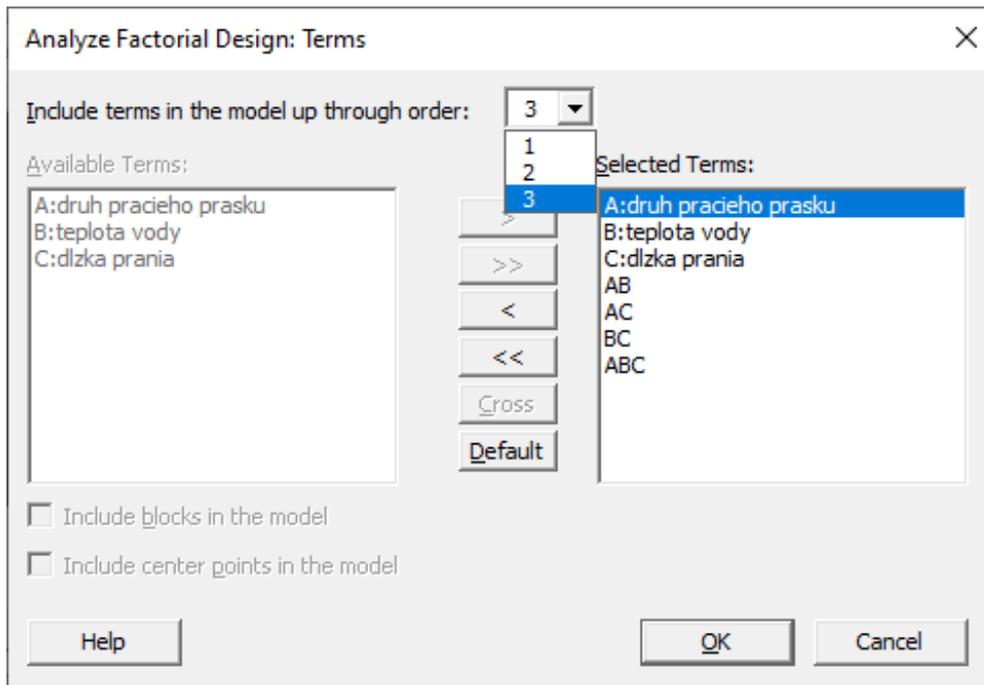
Help OK Cancel

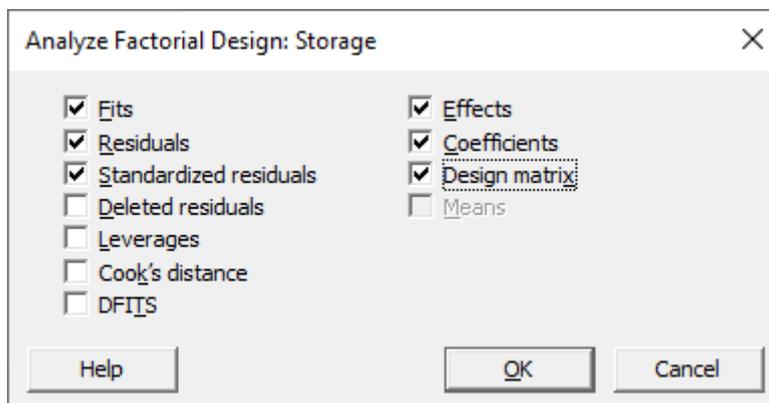
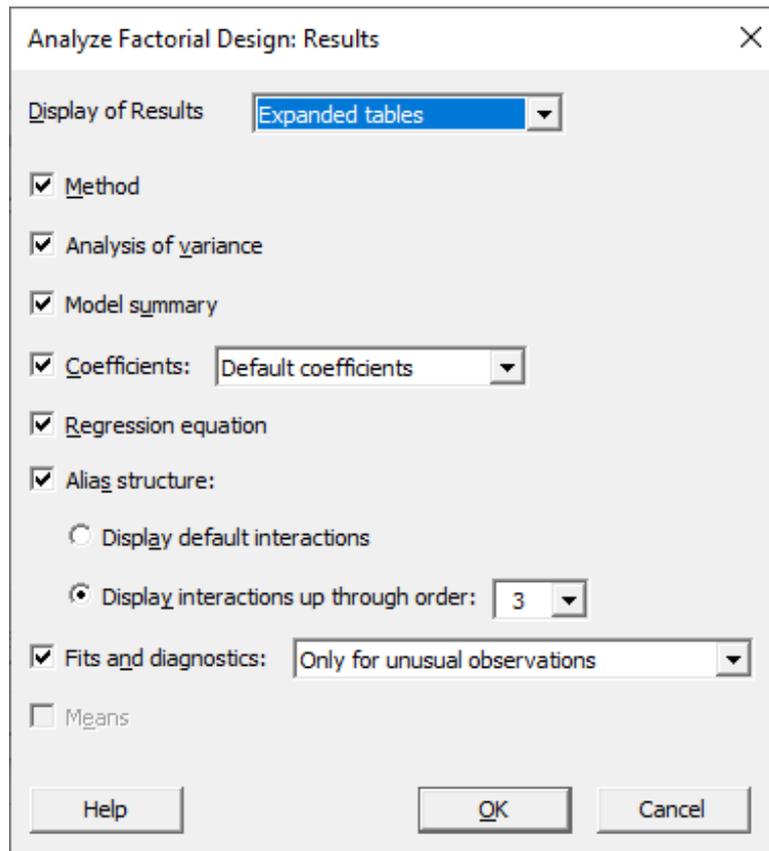
Design Summary

Factors: 3 Base Design: 3; 8
 Runs: 16 Replicates: 2
 Blocks: 1 Center pts (total): 0

2. ANALÝZA A VYHODNOTENIE EXPERIMENTU







Minitab - pranie.mpx
File Edit Data Calc Stat Graph View Help Assistant Predictive Analytics Module Additional Tools

Navigator
Full Factorial Design
Factorial Regression: ucinnost pr...

Factorial Regression: ucinn...
WORKSHEET 1
Factorial Regression: ucinnost prania versus druh pracieho prasku; teplota vody; dlzka prania

Coded Coefficients

Term	Effect	Coef	SE Coef	95% CI
Constant	68,563	0,325	0,325	(67,814; 69,311)
druh pracieho prasku	20,625	10,313	0,325	(9,564; 11,061)
teplota vody	-6,125	-3,063	0,325	(-3,811; -2,314)
dlzka prania	18,875	9,438	0,325	(8,689; 10,186)
druh pracieho prasku*teplota vody	11,375	5,687	0,325	(4,939; 6,436)
druh pracieho prasku*dlzka prania	2,375	1,188	0,325	(0,439; 1,936)
teplota vody*dlzka prania	-3,875	-1,938	0,325	(-2,686; -1,189)
druh pracieho prasku*teplota vody*dlzka prania	-5,375	-2,688	0,325	(-3,436; -1,939)

Term	T-Value	P-Value	VIF
Constant	211,12	0,000	
druh pracieho prasku	31,75	0,000	1,00
teplota vody	-9,43	0,000	1,00
dlzka prania	29,06	0,000	1,00
druh pracieho prasku*teplota vody	17,51	0,000	1,00
druh pracieho prasku*dlzka prania	3,66	0,006	1,00
teplota vody*dlzka prania	-5,97	0,000	1,00

#	C1	C2	C3	C4	C5-T	C6	C7	C8	C9	C10	C11	C12	C13	C14
	StdOrder	RunOrder	CenterPt	Blocks	druh pracieho prasku	teplota vody	dlzka prania	ucinnost prania	FITS1	RES11	SRES1	COEF1	EFFE1	
1	1	1	1	1	1 A1		40	30	60	59,5	0,5	0,54433	68,5625	20,625
2	2	2	1	1	1 A2		40	30	60	61,0	-1,0	-1,08866	10,3125	-6,125
3	3	3	1	1	1 A1		60	30	42	40,5	1,5	1,63299	-3,0625	18,875
4	4	4	1	1	1 A2		60	30	75	75,5	-0,5	-0,54433	9,4375	11,375
5	5	5	1	1	1 A1		40	120	73	74,5	-1,5	-1,63299	5,6875	2,375
6	6	6	1	1	1 A2		40	120	92	91,5	0,5	0,54433	1,1875	-3,875
7	7	7	1	1	1 A1		60	120	59	58,5	0,5	0,54433	-1,9375	-5,375
8	8	8	1	1	1 A2		60	120	87	87,5	-0,5	-0,54433	-2,6875	
9	9	9	1	1	1 A1		40	30	59	59,5	-0,5	-0,54433		
10	10	10	1	1	1 A2		40	30	62	61,0	1,0	1,08866		
11	11	11	1	1	1 A1		60	30	39	40,5	-1,5	-1,63299		
12	12	12	1	1	1 A2		60	30	76	75,5	0,5	0,54433		
13	13	13	1	1	1 A1		40	120	76	74,5	1,5	1,63299		
14	14	14	1	1	1 A2		40	120	91	91,5	-0,5	-0,54433		
15	15	15	1	1	1 A1		60	120	58	58,5	-0,5	-0,54433		
16	16	16	1	1	1 A2		60	120	88	87,5	0,5	0,54433		
17														

HODNOTY EFEKTOV FAKTOROV A KOEFICIENTY A INTERVALY SPOĽAHLIVOSTI V TRANSFORMOVANEJ REGRESNEJ ROVNICI – V KÓDOVANÝCH SÚRADNICIACH

Coded Coefficients

Term	Effect	Coef	SE Coef	95% CI
Constant		68,563	0,325	(67,814; 69,311)
druh pracieho prasku	20,625	10,313	0,325	(9,564; 11,061)
teplota vody	-6,125	-3,063	0,325	(-3,811; -2,314)
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druh pracieho prasku*teplota vody	11,375	5,687	0,325	(4,939; 6,436)
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teplota vody*dlzka prania	-3,875	-1,938	0,325	(-2,686; -1,189)
druh pracieho prasku*teplota vody*dlzka prania	-5,375	-2,688	0,325	(-3,436; -1,939)

POSÚDENIE ŠTATISTICKEJ VÝZNAMNOSTI JEDNOTLIVÝCH KOEFIČIENTOV

Term	T-Value	P-Value	VIF
Constant	211,12	0,000	
druh pracieho prasku	31,75	0,000	1,00
teplota vody	-9,43	0,000	1,00
dlzka prania	29,06	0,000	1,00
druh pracieho prasku*teplota vody	17,51	0,000	1,00
druh pracieho prasku*dlzka prania	3,66	0,000	1,00
teplota vody*dlzka prania	-5,97	0,000	1,00
druh pracieho prasku*teplota vody*dlzka prania	-8,28	0,000	1,00

ANALÝZA ROZPTYLU

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
1,29904	99,66%	99,37%	54	98,65%	90,69	67,64

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS
Model	7	3992,44	99,66%	3992,44
Linear	3	3276,69	81,80%	3276,69
druh pracieho prasku	1	1701,56	42,48%	1701,56
teplota vody	1	150,06	3,75%	150,06
dlzka prania	1	1425,06	35,57%	1425,06
2-Way Interactions	3	600,19	14,98%	600,19
druh pracieho prasku*teplota vody	1	517,56	12,92%	517,56
druh pracieho prasku*dlzka prania	1	22,56	0,56%	22,56
teplota vody*dlzka prania	1	60,06	1,50%	60,06
3-Way Interactions	1	115,56	2,88%	115,56
druh pracieho prasku*teplota vody*dlzka prania	1	115,56	2,88%	115,56
Error	8	13,50	0,34%	13,50
Total	15	4005,94	100,00%	

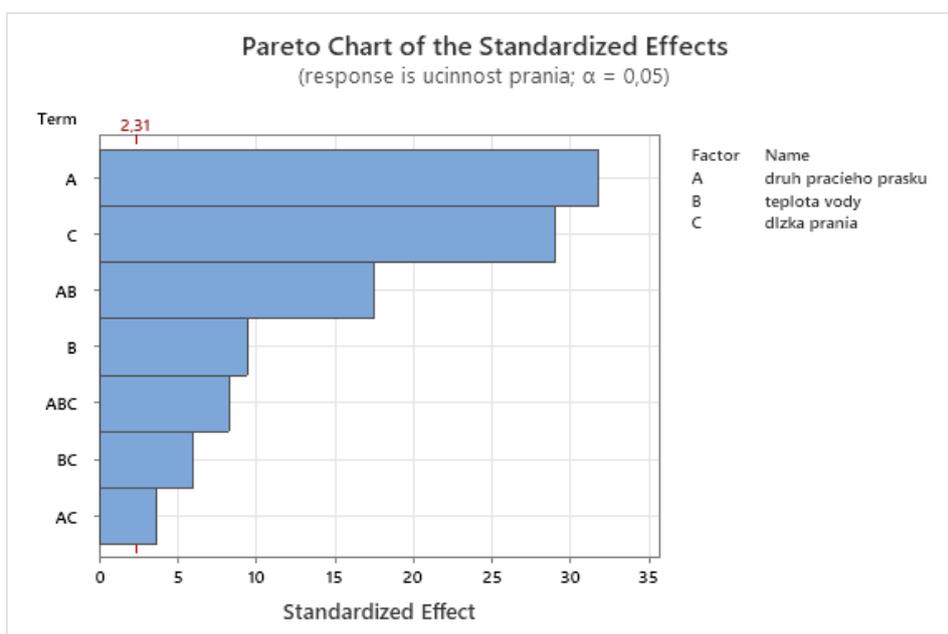
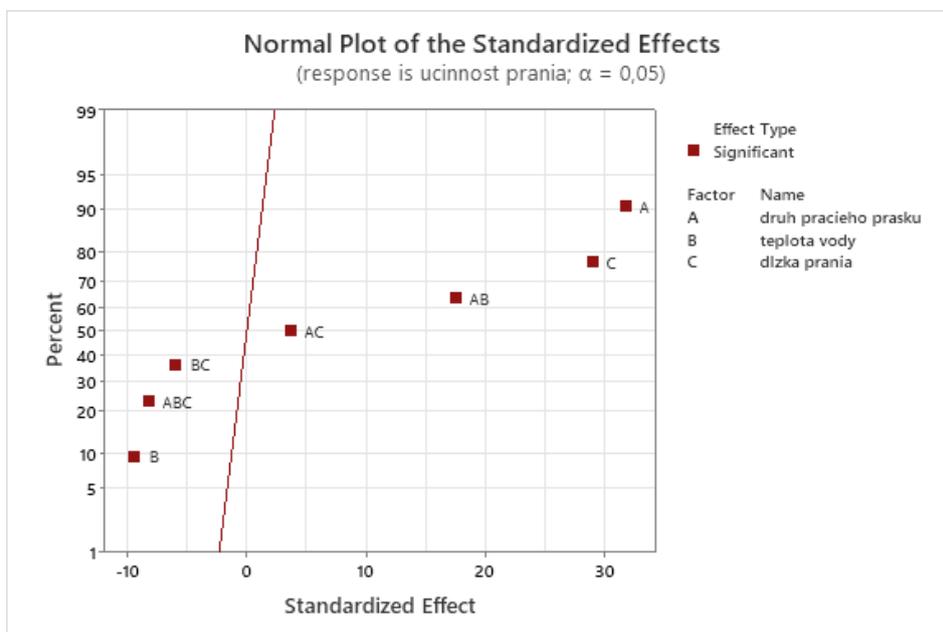
Source	Adj MS	F-Value	P-Value
Model	570,35	337,98	0,000
Linear	1092,23	647,25	0,000
druh pracieho prasku	1701,56	1008,33	0,000
teplota vody	150,06	88,93	0,000
dlzka prania	1425,06	844,48	0,000
2-Way Interactions	200,06	118,56	0,000
druh pracieho prasku*teplota vody	517,56	306,70	0,000
druh pracieho prasku*dlzka prania	22,56	13,37	0,006
teplota vody*dlzka prania	60,06	35,59	0,000
3-Way Interactions	115,56	68,48	0,000
druh pracieho prasku*teplota vody*dlzka prania	115,56	68,48	0,000
Error	1,69		
Total			

REGRESNÝ MODEL – ROVNICA LINEÁRNEHO TYPU V PÔVODNÝCH SÚRADNICIACH

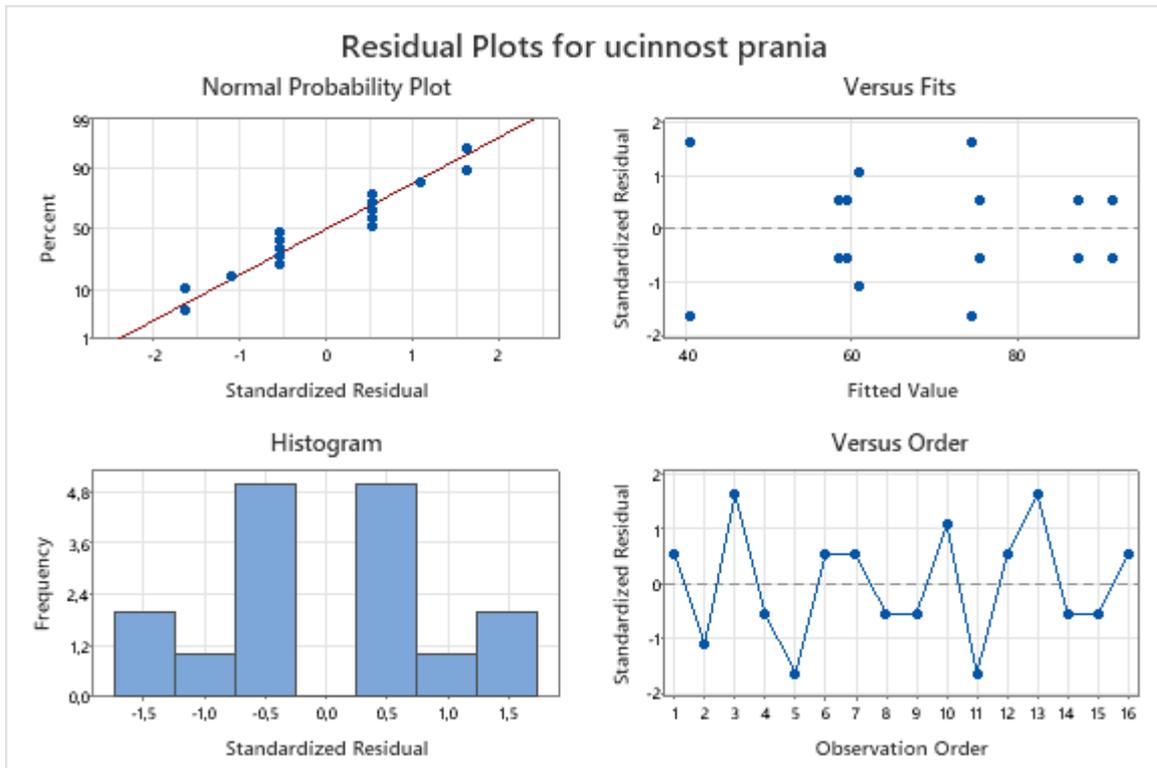
Regression Equation in Uncoded Units

$$\begin{aligned} \text{ucinnost prania} &= 52,00 - 42,50 \text{ druh pracieho prasku} + 0,0167 \text{ teplota vody} \\ &+ 0,4250 \text{ dlzka prania} \\ &+ 1,0167 \text{ druh pracieho prasku} * \text{teplota vody} \\ &+ 0,3250 \text{ druh pracieho prasku} * \text{dlzka prania} \\ &- 0,004306 \text{ teplota vody} * \text{dlzka prania} \\ &- 0,005972 \text{ druh pracieho prasku} * \text{teplota vody} * \text{dlzka prania} \end{aligned}$$

ŠTATISTICKÁ VÝZNAMNOSŤ FAKTOROV - GRAFICKY



GRAFICKÁ ANALÝZA REZÍDUIÍ



HLAVNÉ EFEKTY A INTERAKCIE

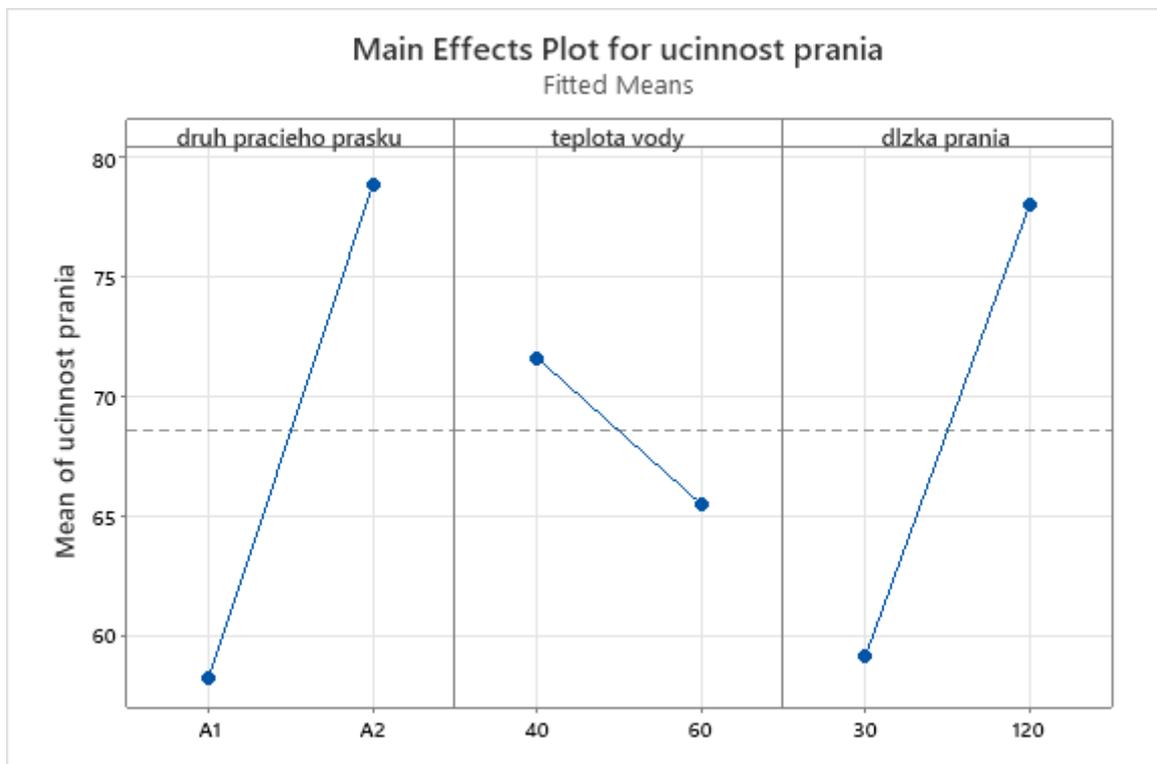
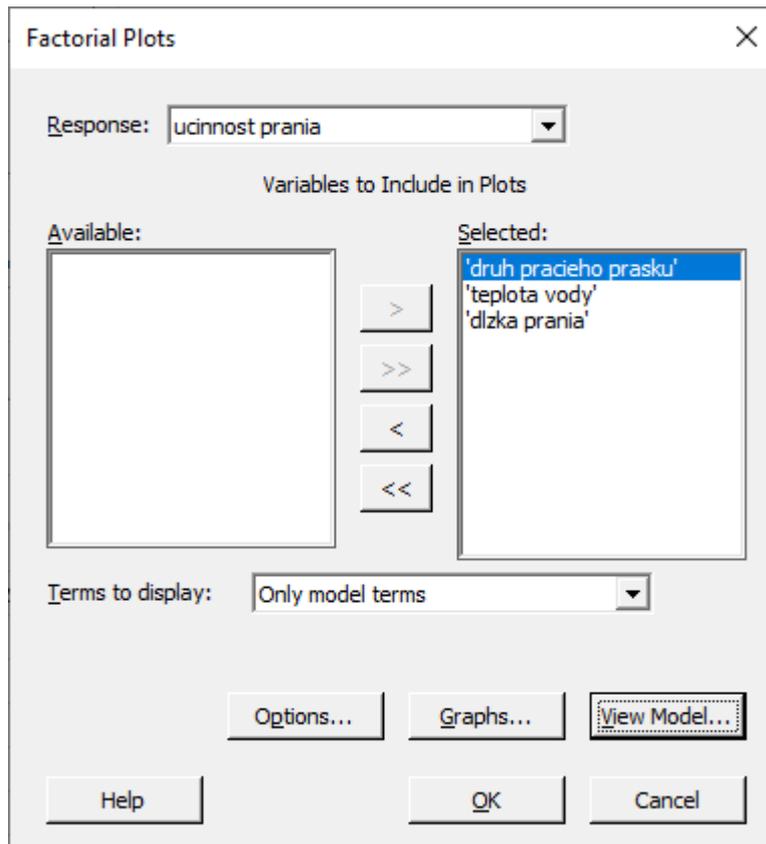
The screenshot shows the Minitab software interface with the 'Stat' menu open. The path for performing a factorial regression analysis is highlighted:

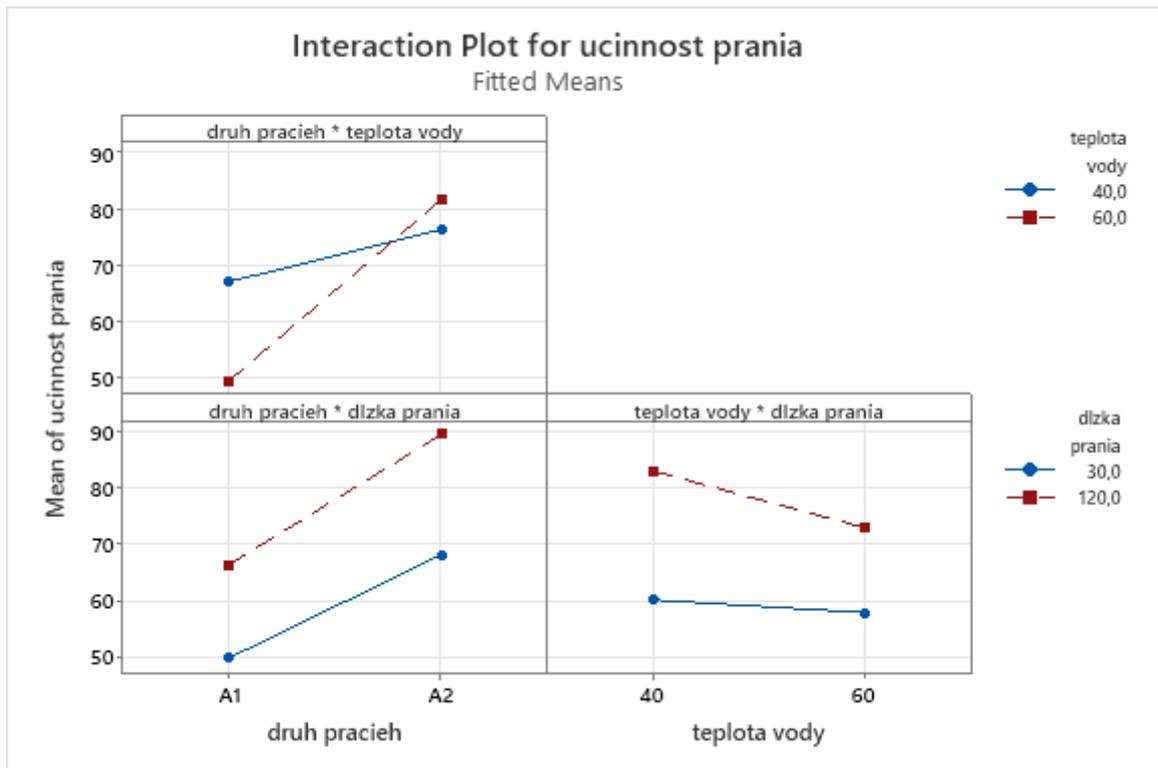
- Stat > Regression > ANOVA > in: ucinn... > Factorial

The 'Factorial' sub-menu is also open, showing options such as 'Create Factorial Design...', 'Define Custom Factorial Design...', 'Select Optimal Design...', 'Pre-Process Responses for Analyze Variability...', 'Analyze Factorial Design...', 'Analyze Binary Response...', 'Analyze Variability...', 'Predict...', 'Factorial Plots...', 'Cube Plot...', 'Contour Plot...', 'Surface Plot...', 'Overlaid Contour Plot...', and 'Response Optimizer...'. The 'Factorial Plots...' option is selected.

In the background, a histogram of standardized residuals and a line plot of standardized residuals versus observation order are visible, similar to the plots in the first figure.

Text on the right side of the screenshot reads: "teplota vody; dlzka prania".





PREDIKCIA

Predict
✕

Response: ucinnost prania

Include covariates in prediction

Enter individual values ▼

✕

'druh pracieho p'	'teplota vody'	'dlzka prania'
A1	50	45
▼		
▼		
▼		
▼		
▼		

Select

Options...

Results...

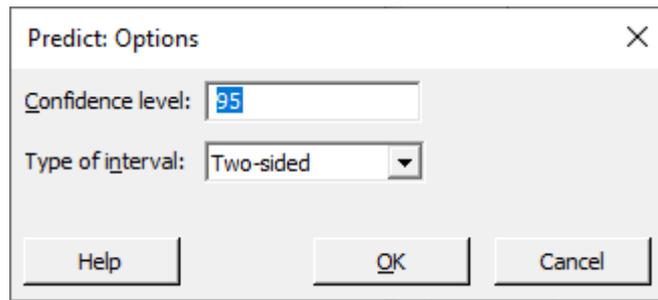
Storage...

View Model...

Help

OK

Cancel



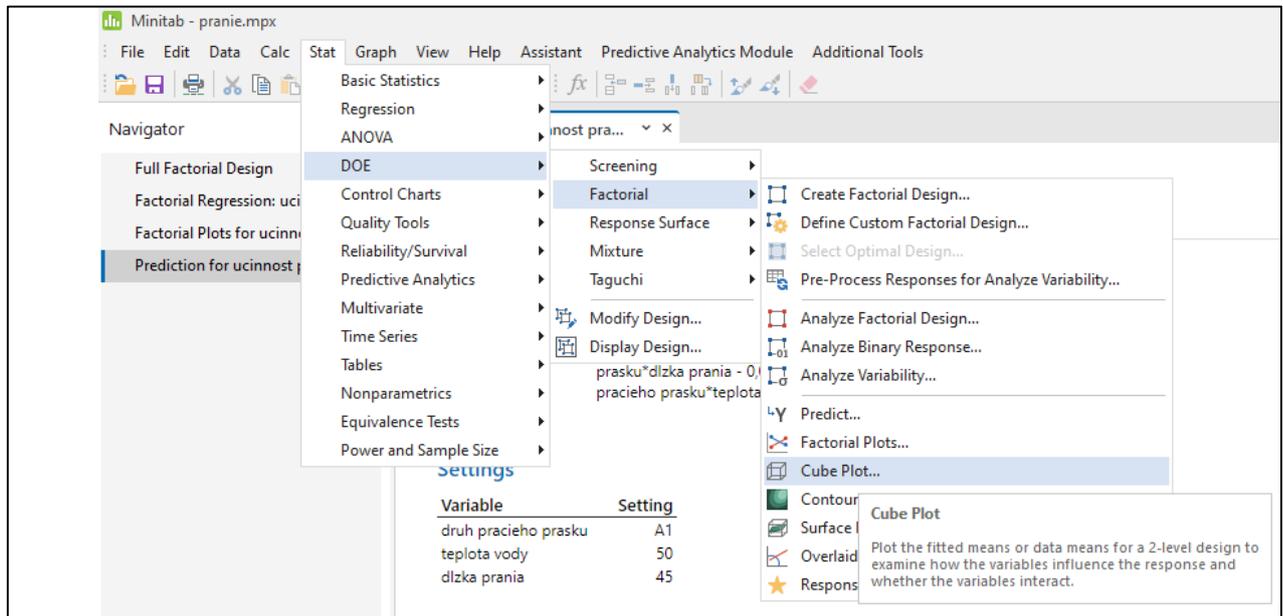
Settings

Variable	Setting
druh pracieho prasku	A1
teplota vody	50
dlzka prania	45

Prediction

Fit	SE Fit	95% CI	95% PI
52,75	0,551985	(51,4771; 54,0229)	(49,4952; 56,0048)

C – PLOT



Cube Plot ✕

C8 ucinnost prania
C9 FITS1
C10 RESI1
C11 SRES1

Type of means to use in plots:

Data means
 Fitted means

Response: (optional)

Variables to Include in Plots

Available:

>

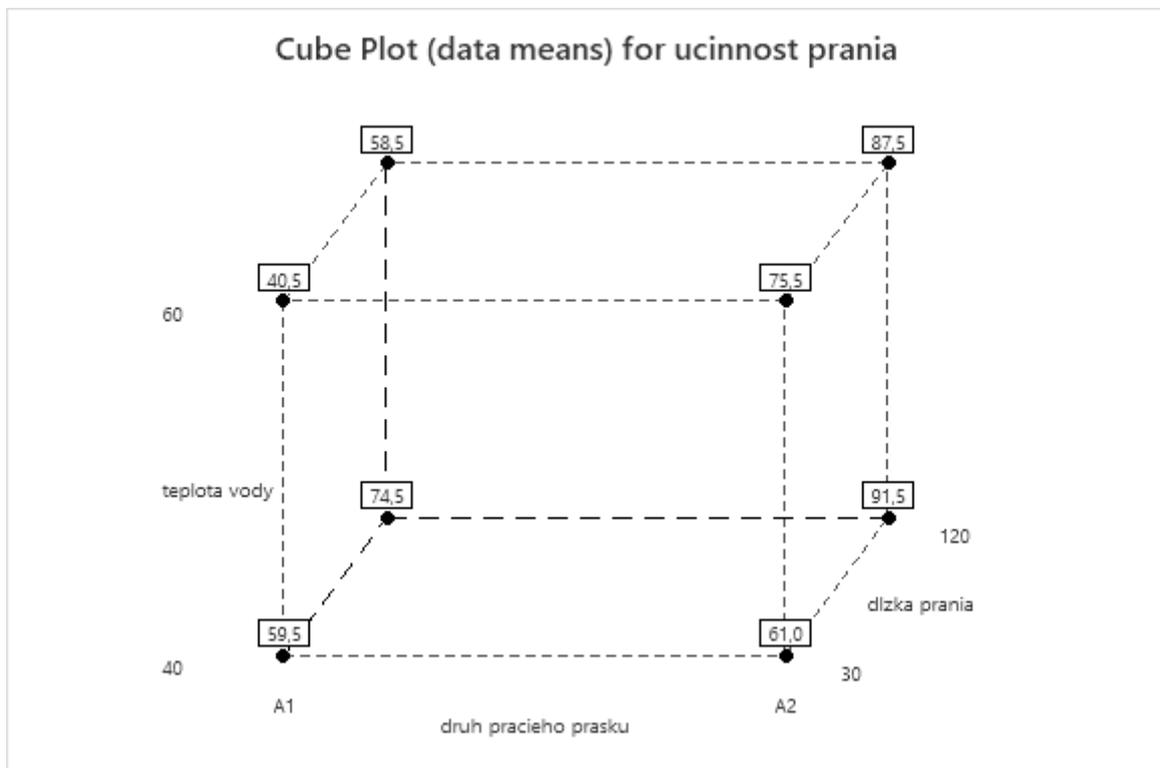
>>

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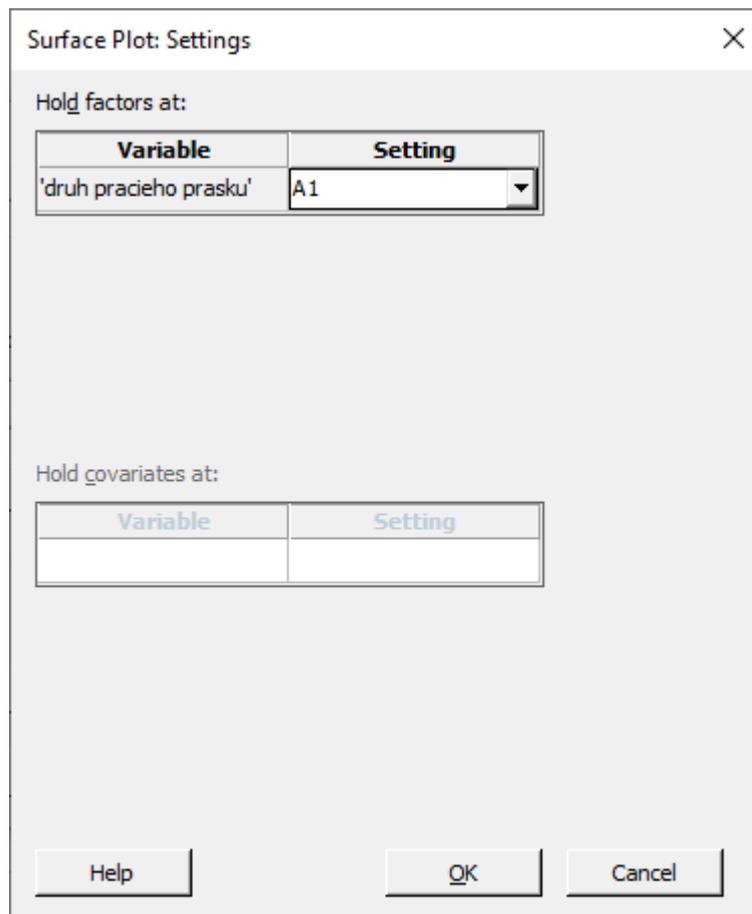
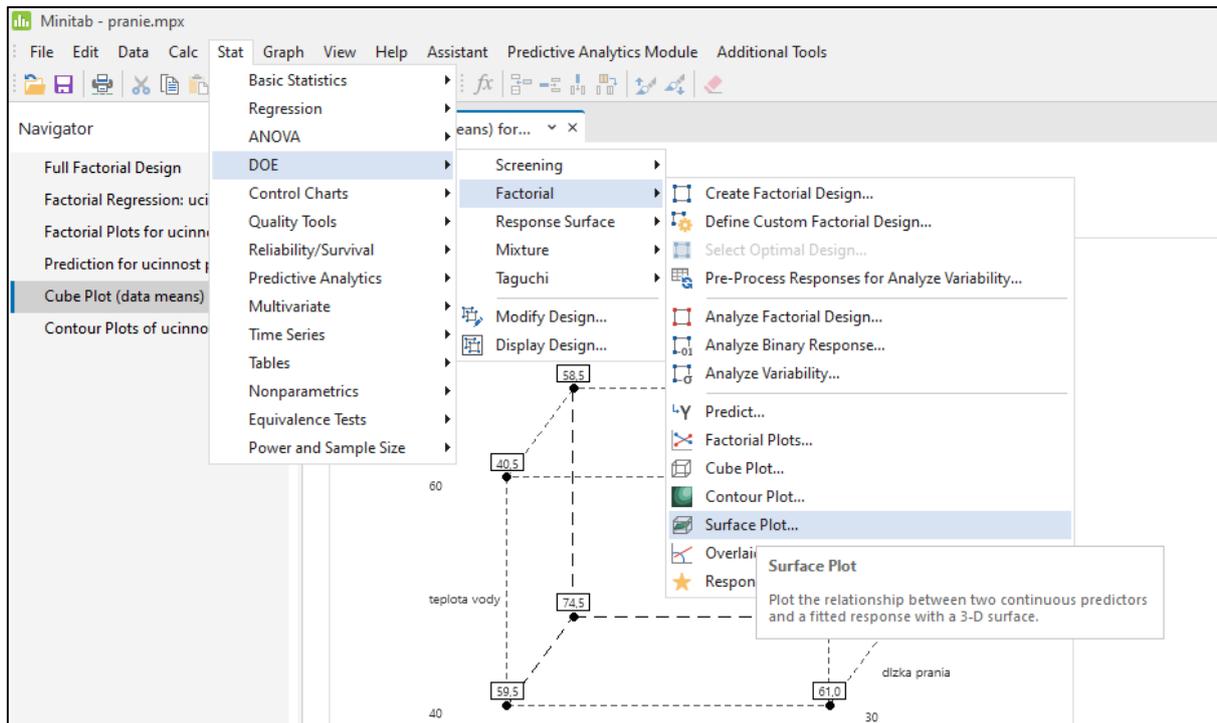
<<

Selected:

A:druh pracieho prasku
B:teplota vody
C:dlzka prania

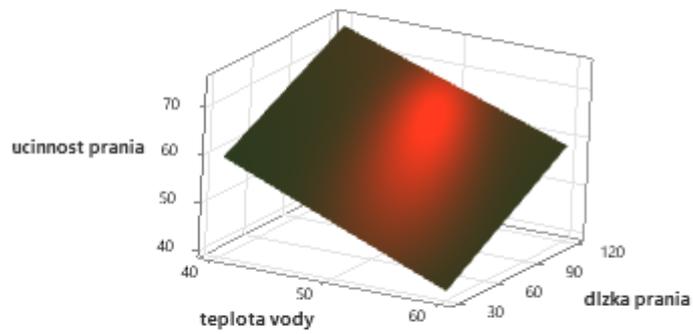


GRAF ODOZVOVEJ PLOCHY



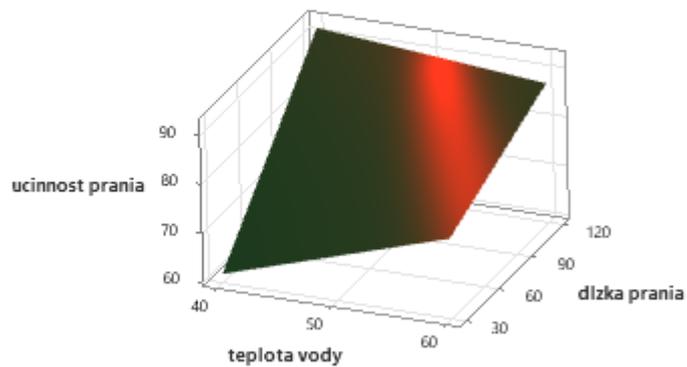
Graf ucinnost prania vs dlzka prania a teplota vody

Hold Values
druh pracieho prasku A1

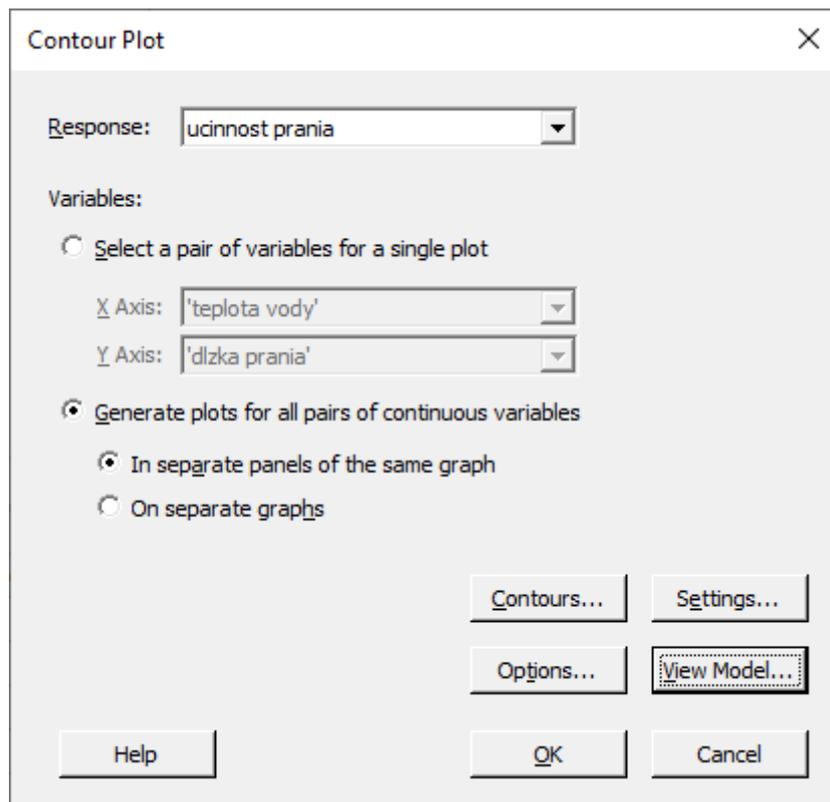
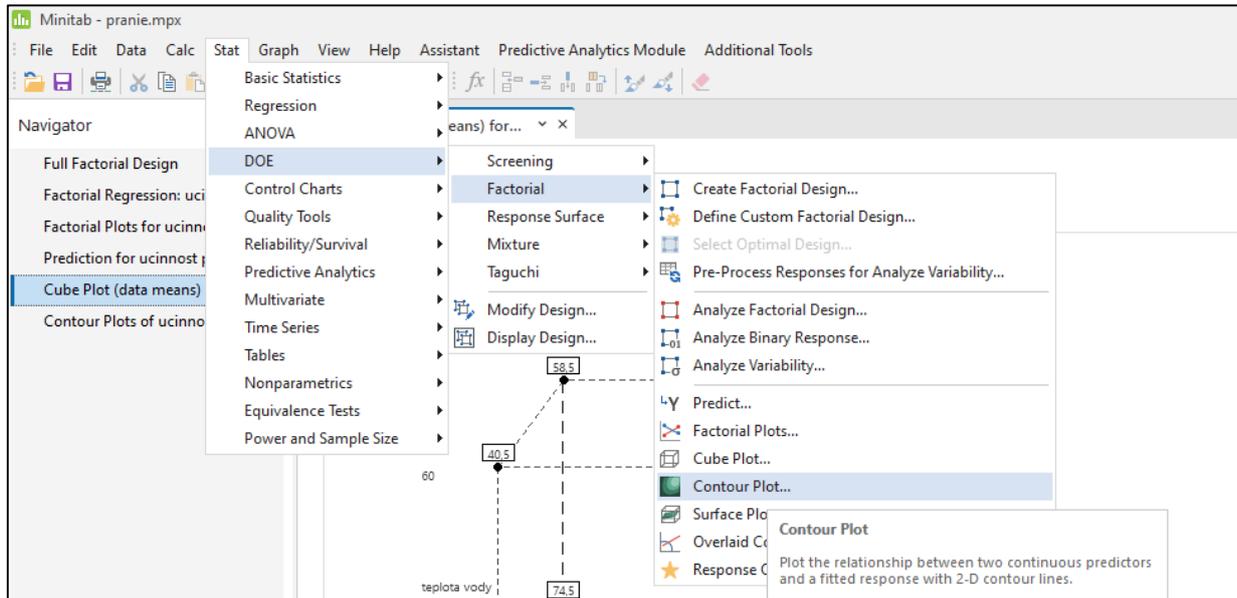


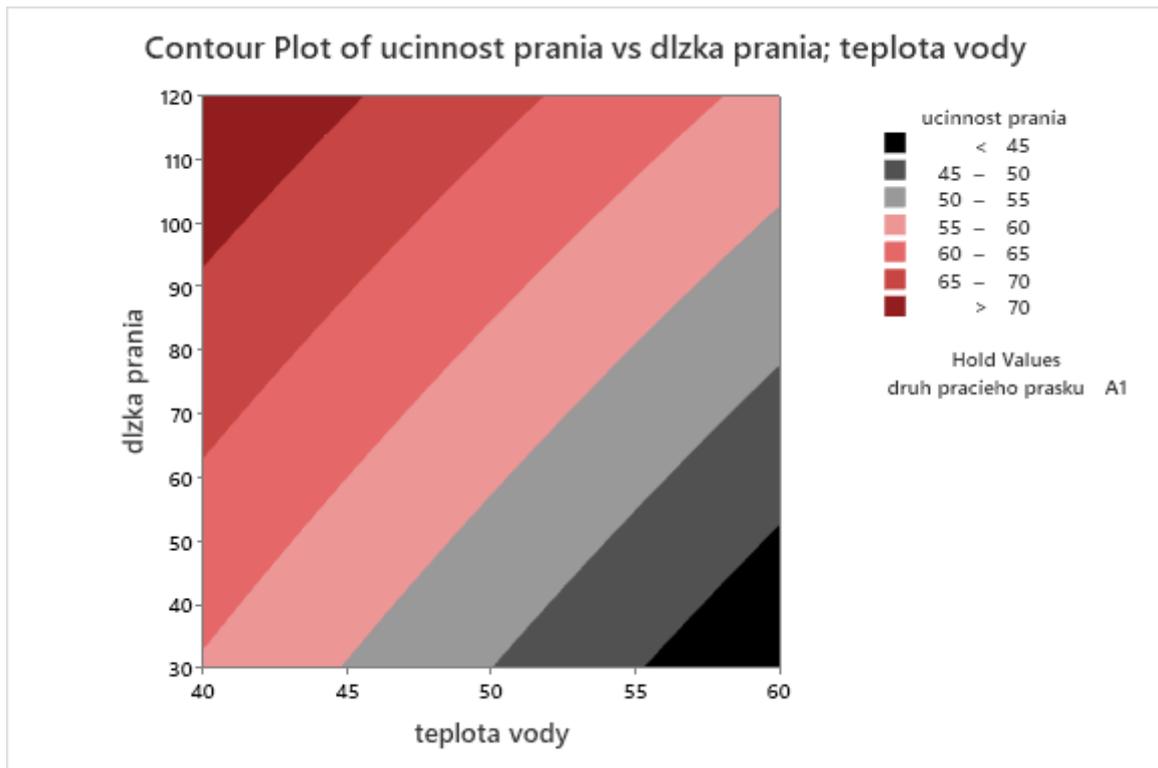
Surface Plot of ucinnost prania vs dlzka prania; teplota vody

Hold Values
druh pracieho prasku A2



VRSTEVNICOVÝ GRAF





OPTIMALIZÁCIA ÚČINNOSTI PRANIA

Stat > **DOE** > **Factorial** > **Response Optimizer...**

variable	Values
druh pracieho prasku	A1; A2
teplota vody	(40; 60)
dlzka prania	(30; 120)

Solutions

druh pracieho

Response Optimizer
Identify the combination of predictor values that jointly optimize one or more fitted responses.

Response Optimizer

Optimize up to 25 responses:

Response	Goal	Target
ucinnost prania	Maximize	

Response Optimizer: Setup

Response	Goal	Lower	Target	Upper	Weight	Importance
ucinnost prania	Maximize	39	92	92	1	1

Desirability functions for different goals - how weights affect their shapes

Minimize the response

Hit a target value

Maximize the response

Response Optimizer: Options ✕

Constraints

Variable	Constraint	Hold Value	Lower	Upper
'druh pracieho prasku'	No constraints	A1	A1	A2
'teplota vody'	Constrain to region		40	60
'dlzka prania'	Constrain to region		30	120

Starting Values ✕

Variable	Starting Value
'druh pracieho prasku'	
'teplota vody'	
'dlzka prania'	

Confidence level for all intervals:

Type of confidence level:

Response Optimizer: Results ✕

Parameters
 Solutions
 Number of solutions to display:
 Prediction
 Variable ranges
 Starting point

File Edit Data Calc Stat Graph View Help Assistant Predictive Analytics Module Additional Tools

Response Optimization: uci... x

WORKSHEET 1

Response Optimization: ucinnost prania

Parameters

Response	Goal	Lower	Target	Upper	Weight	Importance
ucinnost prania	Maximum	39	92		1	1

Variable Ranges

Variable	Values
druh pracieho prasku	A1; A2
teplota vody	(40; 60)
dlzka prania	(30; 120)

Solutions

Solution	druh pracieho prasku	teplota vody	dlzka prania	ucinnost prania Fit	Composite Desirability
1	A2	40,0000	120,000	91,5000	0,990566
2	A2	40,0639	111,004	88,4445	0,932915
3	A2	60,0000	37,397	76,4863	0,707289
4	A1	40,0000	120,000	74,5000	0,669811
5	A2	56,4773	35,561	73,8888	0,658280
6	A1	43,1798	119,996	71,9554	0,621800
7	A1	40,0000	46,463	62,2439	0,438564
8	A1	60,0000	30,000	40,5000	0,028302

Multiple Response Prediction

Variable	Setting			
druh pracieho prasku	A2			
teplota vody	40			
dlzka prania	120			
Response	Fit	SE Fit	95% CI	95% PI
ucinnost prania	91,500	0,919	(89,382; 93,618)	(87,831; 95,169)